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Device at fixing means for fixation of bone fragments at bone fractures.

The present invention relates to a device at fixing means for fixation of bone fragments at bone fractures, wherein the fixing means preferably is a spike for thigh-bone necks for fixation of bone fragments at fractures of the thigh-bone neck, wherein the fixing means comprises a sleeve which is open at the rear for insertion of a pin into a ready position, wherein the sleeve defines an elongated space with two opposite wall surfaces, namely a first longitudinal wall surface in which there is provided a side opening and a longitudinal second wall surface from which a guide surface extends in an inclined forward direction to a front edge of the side opening, and wherein the guide surface is provided to guide a front, preferably curved end portion of the pin to force its way out through the side opening when said pin is displaced in a forward direction relative to the sleeve.

Fixing means of the abovementioned type are known from SE 431 053 (US 4 498 468) and have operated satisfactory for many years.

There is however, always a risk that the pin does not find its way out through the side opening, but is deformed inside the sleeve if it occupies or is brought to occupy an erroneous position in relation thereto. This may be due to that the pin unintentionally moves or is moved from a ready position, e.g. by being turned or rotated relative to the sleeve through the influence from rotatable members of a driving or actuator instrument. There is also a risk that those parts of the front end portion of the pin which are driven into surrounding bone material are not deformed into an advantageous curvature. This results in that there is a risk that the fixing means does not get the intended function, namely stable fixation of the bone fragments relative to each other. There is also a risk that the front end portion of the

2.

pin due to a faulty design penetrates the bone fragment it is forced into.

The object of the present invention has been to eliminate this problem and this is arrived at by providing the abovementioned device with the characterizing features of subsequent claim 1.

By providing the device with said characterizing features, the pin is prevented from unintentional movement out of a ready position and/or is it ensured that the end portion of the pin gets an advantageous curvature such that a stable fixation of the bone fragment is obtained and the likelihood that said pin penetrates the bone fragment is reduced.

The invention will be further described below with references to the accompanying drawings, in which

fig. 1 is a longitudinal section through a fixing means with a device according to the invention;

fig. 2 illustrates the fixing means of fig. 1 with a front portion of a pin protruding from a sleeve;

fig. 3 illustrates a pin forming part of the fixing means of fig. 1, in an unstrained initial shape;

fig. 4 is a section IV-IV through the fixing means of fig. 1;

fig. 5 is a section V-V through the fixing means of fig. 1; and

fig. 6 illustrates front parts of a sleeve with an alternative design and forming part of the fixing means of fig. 1.

The fixing means 1 illustrated in the drawings is adapted for fixation of bone fragments at bone fractures. Preferably, the fixing means 1 is a spike for thigh-bone necks, a collum spike, for fixation of bone fragments 2, 3 at fractures 4 of the thigh-bone neck.

The spike 1 comprises a sleeve 5 with an elongated space 6 which is open at the rear for insertion of a pin 7. The elongated space 6 has a circular or substantially circular cross section.

3.

The sleeve 5 has a first longitudinal wall surface 8 and opposite thereto, a second longitudinal wall surface 9. In the first longitudinal wall surface 8 there is provided a side opening 10 and from a front edge 13 of said side opening 10, a guide surface 12 protrudes in a backwards inclined direction to the second longitudinal wall surface 9.

The pin 7 has a front end portion 7f which preferably is curved. This front end portion 7f is adapted to be guided by the guide surface 12 such that it is forced out of the space 6 through the side opening 10 and into adjacent bone fragment 3.

A front part 7a of the pin 7 close to its front end portion 7f extends in an inclined forward direction towards front parts 9a of the second longitudinal wall surface 9 and is preferably adapted to have contact with said front parts 9a at the guide surface 12 when the pin 7 is in a ready position B (see fig. 1) from which it can be driven farther into the elongated space 6 in order to force the front end portion 7f out through the side opening 10. In this ready position B, contact members 7b between said front part 7a and an intermediate part 7d of the pin 7 are in contact with the first longitudinal wall surface 8 behind the side opening 10.

The front end portion 7f of the pin 7 preferably has a height h which is greater than the distance a between the first and second longitudinal wall surfaces 8 and 9. Thus, the height h of the front end portion 7f may be about 4,5 mm while the distance a is about 4 mm. The pin 7 is capable of being bent such that the front end portion 7f can be inserted into the elongated space 6 when the pin 7 is moved to the ready position B. When the pin 7 has reached the ready position B, the front end portion 7f can snap into the side opening 10.

When the pin 7 is in the ready position B and/or when it is driven into the elongated space 6 to force its front end portion 7f out through the side opening 10,

4.

said front end portion 7f of the pin 7 preferably is in contact with central parts of the guide surface 12 about halfway between the front edge 13 of the side opening 10 and the second longitudinal wall surface 9.

5 The front end portion 7f of the pin 7 projects preferably into the side opening 10, but not out of the sleeve 5 beyond its outer profiles when said pin 7 is in the ready position B.

10 The pin 7 is designed relative to the space 6 in the sleeve 5 such that it in the ready position B does not move unintentionally out of said space 6 relative to said sleeve 5.

15 The pin 7 is adapted to be driven into the sleeve 5 by means of a driving or actuator instrument 15. This instrument may comprise three members schematically illustrated with broken lines in fig. 1, namely an outer sleeve 15a which can be brought to engage the rear edge 23 of the sleeve 5 such that said outer sleeve 15a can not turn or rotate relative to the sleeve 5. Said outer sleeve 15a
20 can be held in this position by means of an inner sleeve 15b having outer threads which permit meshing of said outer sleeve with inner threads in the sleeve 5.

25 The driving instrument 15 further comprises a driving or actuator unit 15c which has outer threads permitting it to be secured to inner threads in the inner sleeve 15b. Since thereby the driving unit 15c is in contact with the rear edge 17 of the pin 7, it will drive or force the pin 7 into the space 6 in the sleeve 5 and thus, press the front end portion 7f of the pin 7 out of the side
30 opening 10, whereby said front end portion 7f is deformed.

Driving or actuator instruments of this type are already known from SE 431 053 (US 4 498 468) and therefore not further described here.

35 The pin 7 is also designed relative to the space 6 of the sleeve 5 such that it can not rotate about its longitudinal axis L if and/or when parts of the driving instrument 15 come in contact therewith when said parts

5.

are turned or rotated. This can be achieved by bringing the front end portion 7f of the pin 7 to engage the side opening 10 when said pin 7 is in its ready position B.

The pin 7 preferably has elastic properties or at least a front part 7a thereof has elastic properties. The pin 7 may e.g. consist of such metallic material that it has elastically resilient properties.

The pin 7 may have an original shape U (see fig. 3) which is such relative to the shape of the elongated space 6 in the sleeve 5 that said pin 7, during insertion into said elongated space 6 in the sleeve 5, through deformation is brought into such a strained or stretched condition S (see fig. 1) that it moves or is moved unintentionally relative to the sleeve 5. In order to illustrate the difference there may be between the original shape U of the pin 7 and the shape of the elongated space 6, the latter is shown with broken lines in fig. 3.

The pin 7 is provided to slide against the front part 9a of the second longitudinal wall 9, lying closest to the guide surface 12 when the pin 7 is driven into the elongated space 6. Rear parts 7e of the pin 7 are in contact with the second longitudinal wall 9 of the sleeve 5 when the pin 7 is in the ready position B.

In the ready position B, the front end portion 7f of the pin 7 is preferably in contact with the guide surface 12 a short distance within the side opening 10, such that when the front end portion 7f is forced out through the side opening 10, it assumes a curved shape along its entire or at least the major part of its length.

The pin 7 may, in its original shape U, have a straight or substantially straight rear part 7e and the front part 7a may be straight or substantially straight and directed obliquely forward/sideways relative to the rear part 7e or the pin 7 may e.g. have an S-shape as is shown in fig. 3.

The front part 7a of the pin 7 may have a circular segment-shaped cross section (see fig. 5) and its rear

6.

part 7e a circular cross section (see fig. 4). At the contact part 7b, the circular segment-shaped cross section transforms into the circular cross section. Furthermore, the rear part 7e of the pin 7 may be in contact with the
5 second longitudinal wall 9 through a contact part 7c.

The pin 7 preferably has such a length relative to the length of the elongated space 6 of the sleeve 5 that the rear edge 17 of the pin 7 is situated edge-to-edge with the rear edge 23 of the sleeve or within said rear
10 edge 23 when the pin 7 is fully driven into the sleeve 5. This is advantageous since the pin 7 after finished driving or actuator operation hereby does not project at the rear of the sleeve 5, whereby the risk for tenderness of the patient is reduced.

15 At the back, the pin 7 is provided with a threaded portion (not shown) which after finished driving or actuator operation is located inside the sleeve 5 and which is adapted for cooperation with a correspondingly threaded portion (not shown) on an extractor unit (not shown) for
20 extraction or removal of the pin 7 from the bone fragment 3.

As is apparent from fig. 6, front parts 27 of the sleeve 5 may have external threads for securing the sleeve 5 to the bone fragment 3. The outer diameter of
25 the external threads of the front parts 27 may correspond with or substantially correspond with the outer diameter of unthreaded parts of the sleeve 5 behind said front parts 27.

By means of the embodiment defined above and illustrated in the drawings, the pin 7 will thus remain in a ready position B until its front end portion 7f has
30 been driven or forced into surrounding bone material 2. Another advantage is that the front end portion 7f of the pin 7 will slide against large parts of the guide surface 12 during its displacement, whereby said pin assumes an advantageous curved shape along its entire or almost entire length outside the side opening 10.
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7.

The invention is not limited to the embodiment described above and illustrated in the drawings, but may vary within the scope of the subsequent claims regarding the use and design of the various parts and their function. As examples of embodiments and uses not described above, it can be mentioned that the fixing means 1 can be used for bone fractures on other locations than the thigh-bone neck (neck of the femur), the sleeve 5 may be of metal material or another suitable material, the pin 7 may be of another material than metallic material and the sleeve 5 as well as the pin 7 may have other shapes than those illustrated and yet have the same or similar functions as described above.

8.

Claims:

1. Device at fixing means for fixation of bone fragments at bone fractures,

wherein the fixing means (1) preferably is a spike for thigh-bone necks for fixation of bone fragments (2, 3) at fractures (4) of the thigh-bone neck,

wherein the fixing means (1) comprises a sleeve (5) which is open at the rear for insertion of a pin (7) into a ready position (B),

wherein the sleeve (5) defines an elongated space (6) with two opposite wall surfaces (8, 9), namely a first longitudinal wall surface (8) in which there is provided a side opening (10) and a longitudinal second wall surface (9) from which a guide surface (12) extends in an inclined forward direction to a front edge (13) of the side opening (10), and

wherein the guide surface (12) is provided to guide a front, preferably curved end portion (7f) of the pin (7) to force its way out through the side opening (10) when said pin (7) is displaced in a forward direction relative to the sleeve (5),

characterized in

that the pin (7) closest to the front end portion (7f) includes a front part (7a) which is directed obliquely forward relative to a rear part (7e) thereof and towards front parts (9a) of the second wall surface (9) close to the guide surface (12) when the pin (7) is located in a ready position (B) in the sleeve (5).

2. Device according to claim 1, characterized in that the front part (7a) of the pin (7) is in contact with the front parts (9a) of the second wall surface (9) when the pin (7) is in the ready position (B).

3. Device according to claim 1 or 2, characterized in that the pin (7) is designed such that its front part (7a) slides against the front parts

9.

(9a) of the second wall surface (9) when it is driven or forced into the elongated space (6) of the sleeve (5) in order to bring the front end portion (7f) thereof to protrude or force its way out through the side opening (10).

5 4. Device according to any preceding claim, characterized in that the front end portion (7f) of the pin (7) engage the side opening (10) when the pin (7) is in the ready position (B).

10 5. Device according to claim 4, characterized in

that the pin (7) has an original shape (U) in which a height (h) of the front end portion (7f) is greater than the distance (a) between the first and second longitudinal wall surfaces (8, 9),

15 that the pin (7) is capable of being bent such that the front end portion (7f) can be inserted into the sleeve (5) when the pin (7) is moved to the ready position (B) therein, and

20 that the pin (7) has such elastic properties that the front end portion (7f) snaps into the side opening (10) after having been moved thereto.

25 6. Device according to claim 4 or 5, characterized in that the front end portion (7f) of the pin (7) is situated within the outer profile of the sleeve (5) when it engages the side opening (10).

30 7. Device according to any preceding claim, wherein the pin (7) includes a rear part (7e) which at the front transforms into an intermediate part (7d) which in turn at the front transforms into the front part (7a), characterized in that said intermediate part (7d) is directed obliquely forward towards the first longitudinal wall surface (8) when the pin (7) is in the ready position (B).

35 8. Device according to claim 7, characterized in that a contact part (7b) between said intermediate part (7d) and the front part (7a) is in contact with the first wall surface (8) and that the rear

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part (7e) is in contact with the second wall surface (9) when the pin (7) is in the ready position (B).

9. Device according to any preceding claim, c h a -
r a c t e r i z e d i n that the front end portion (7f)
5 of the pin (7) is in contact with the guide surface (12) when the pin (7) is in the ready position (B).

10. Device according to any preceding claim, c h a -
r a c t e r i z e d i n that the front end portion (7f)
of the pin (7) is in contact with central parts of the
10 guide surface (12) about halfway between the front edge (13) of the side opening (10) and the second longitudinal wall surface (9) when the pin (7) is in said ready position (B) and/or when the pin (7) is driven into the elongated space (6) in order to bring the front end portion
15 (7f) thereof to force its way out through the side opening (10).

11. Device according to any preceding claim, c h a -
r a c t e r i z e d i n that the pin (7) has a rear part (7e) and an intermediate part (7d) with circular
20 cross section as well as a front part (7a) with a circular segment-shaped cross section.

12. Device according to any preceding claim, c h a -
r a c t e r i z e d i n that in the ready position (B), the pin (7) is provided such that it does not turn or
25 rotate and/or can turn or rotate about its longitudinal axis (L) relative to the sleeve (5).

13. Device according to any preceding claim, c h a -
r a c t e r i z e d i n that in the ready position (B), the pin (7) is provided such that it can not rotate about
30 its longitudinal axis (L) relative to the sleeve (5) if it is affected by torsional forces from parts of a driving or actuator instrument (15).

14. Device according to any preceding claim, c h a -
r a c t e r i z e d i n that the pin (7) is mounted
35 in the ready position (B) in a strained or stretched condition.

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15. Device according to any preceding claim, c h a -
r a c t e r i z e d i n that the pin (7) has an origi-
nal shape (U) which deflects from the shape of the elon-
gated space (6) of the sleeve (5) in such a way that the
5 pin (7) is strained or stretched by deformation when it
is inserted into a ready position (B) in the elongated
space (6).

16. Device according to any preceding claim, c h a -
r a c t e r i z e d i n that the front end portion (7f)
10 of the pin (7) is provided such that it is forced out of
the side opening (10) as a curved front end portion (7f)
along its entire or substantially entire length.

17. Device according to any preceding claim, c h a -
r a c t e r i z e d i n that the pin (7) in an origi-
15 nal shape (U) has a straight or substantially straight
rear part (7e) and a straight or substantially straight
front part (7a) which is directed forward/sideways rela-
tive to the rear part (7e).

18. Device according to any preceding claim, c h a -
20 r a c t e r i z e d i n that the pin (7) or at least
a front part (7a) thereof has elastic properties.

19. Device according to any preceding claim, c h a -
r a c t e r i z e d i n that the pin (7) has such a
length relative to the length of the elongated space (6)
25 of the sleeve (5) that a rear edge (17) of the pin (7)
is located edge-to-edge with a rear edge (23) of the
sleeve (5) or within said rear edge (23) when the pin (7)
is fully driven into the sleeve (5), so that the pin (7)
after finished driving or actuator operation does not
30 project at the rear of the sleeve (5).

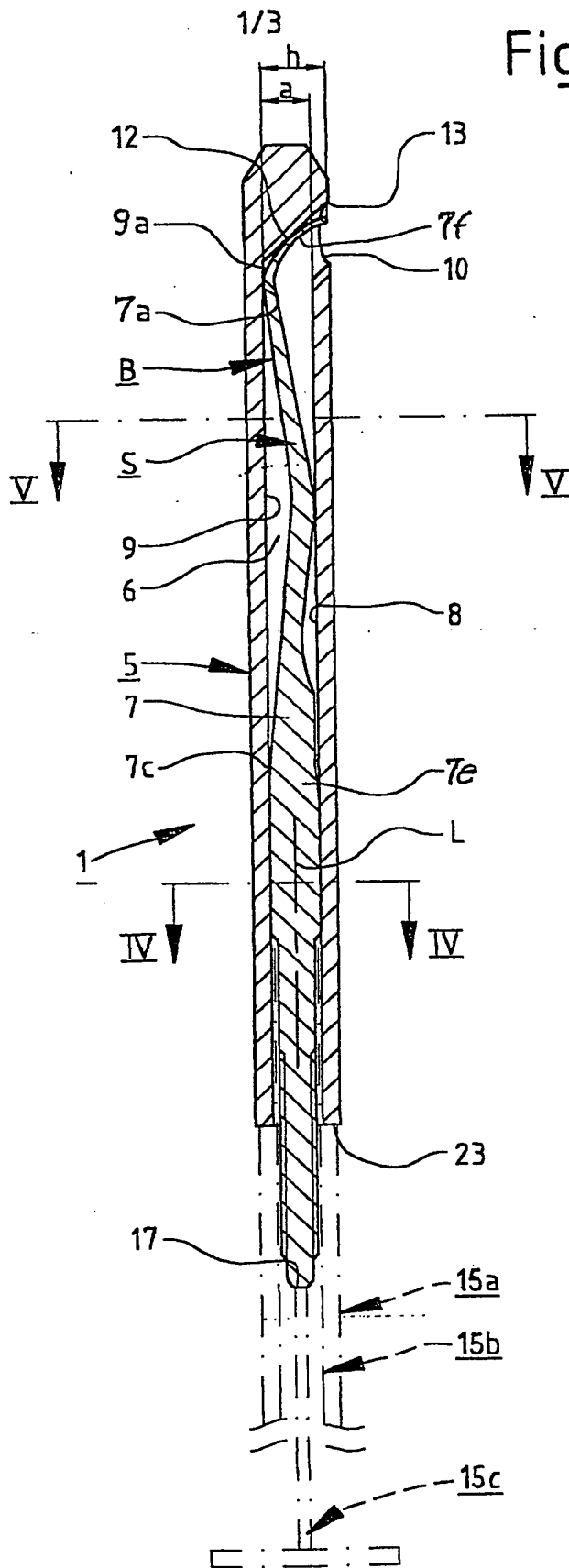
20. Device according to any preceding claim, c h a -
r a c t e r i z e d i n that front parts (27) of the
sleeve (5) have external threads for securing said front
parts (27) to adjacent bone fragment (3).

35 21. Device according to claim 20, c h a r a c t e -
r i z e d i n that the outer diameter of the external
threads of the front parts (27) corresponds or substan-

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tially corresponds with the outer diameter of unthreaded parts of the sleeve (5) behind said front parts (27).

Fig.1



2/3

Fig.2

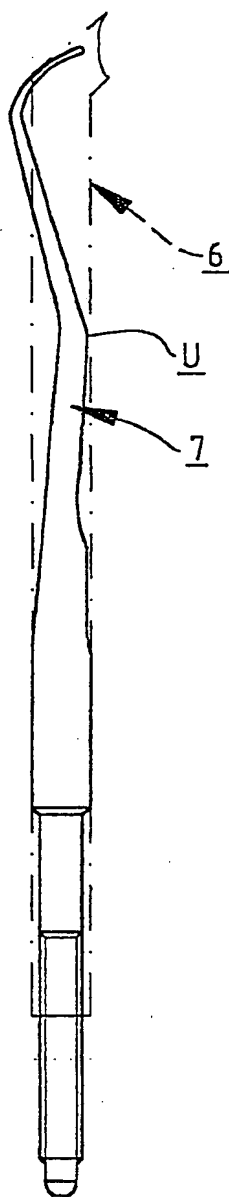
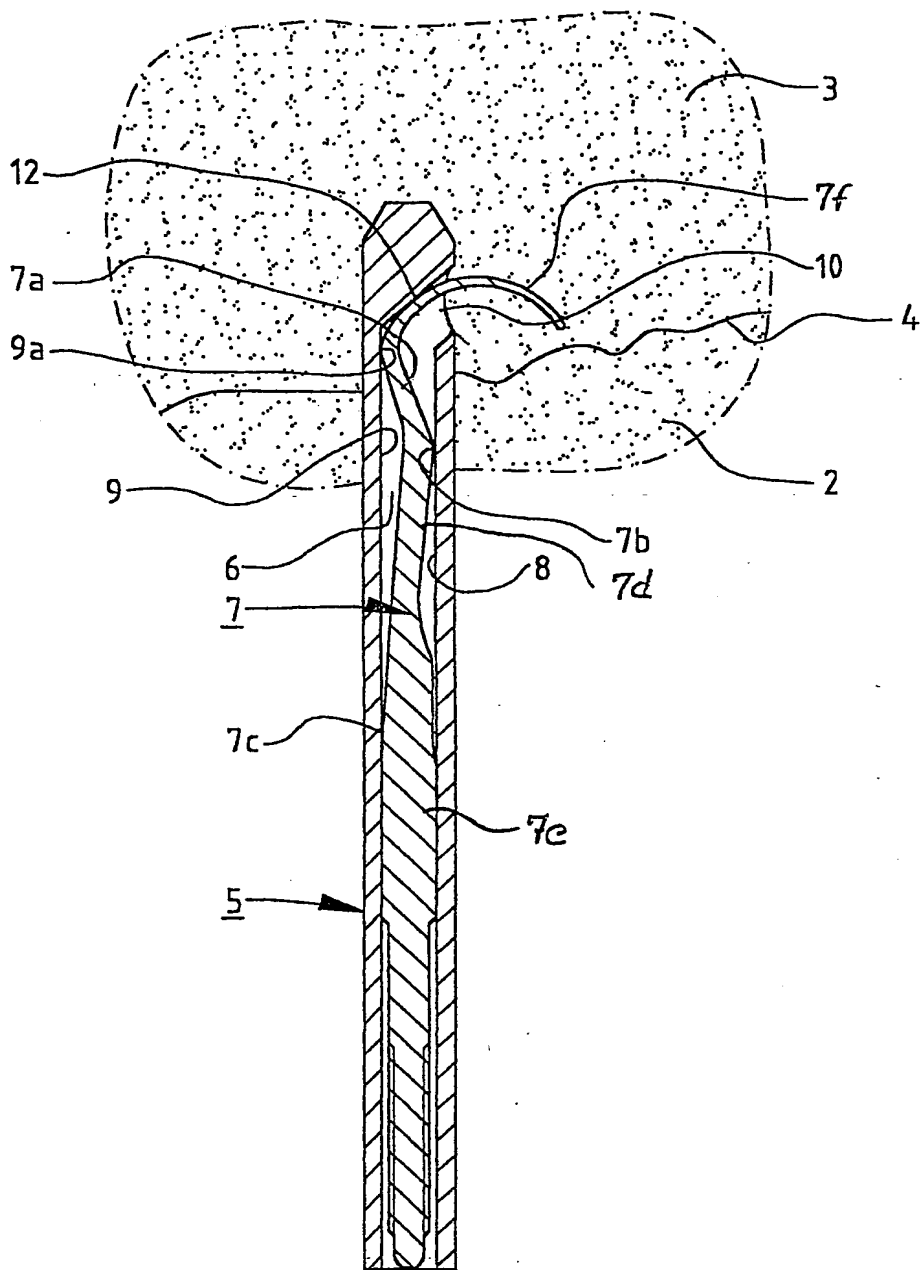
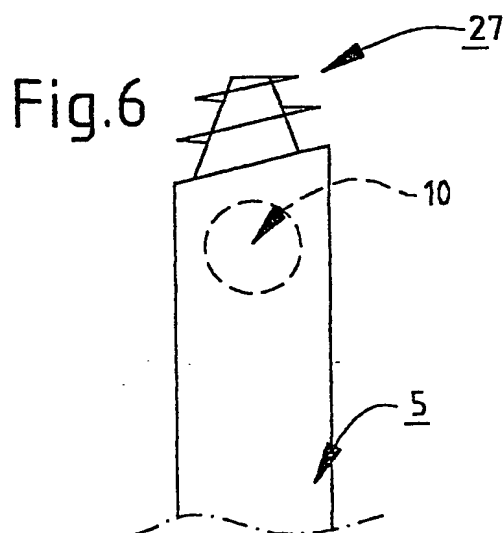
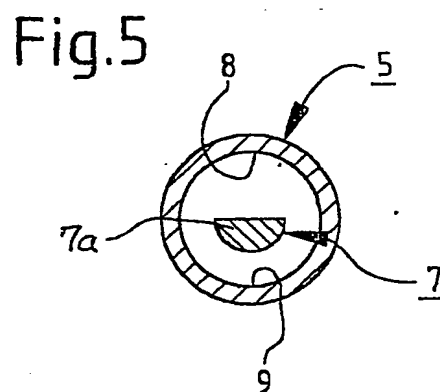
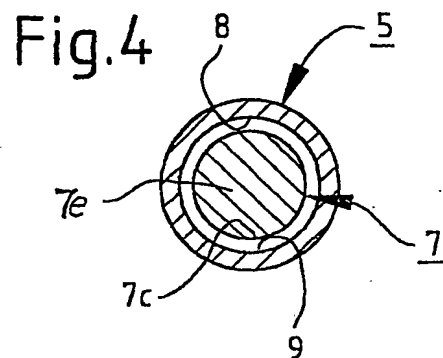


Fig.3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 01/01684

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A61B 17/78

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	WO 9531942 A1 (SANTORI, FRANCESCO, SAVERIO), 30 November 1995 (30.11.95), abstract, figure --	1-21
A	US 6074392 A (ALFRED A. DURHAM), 13 June 2000 (13.06.00), abstract, figure --	1-21
A	US 2998007 A (K. HERZOG), 29 August 1961 (29.08.61), abstract, figure --	1-21

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

9 November 2001

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INTERNATIONAL SEARCH REPORT

International application No.

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C (Continuation). . DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT
Information on patent family members

01/10/01

International application No.

PCT/SE 01/01684

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